

## C L A I M S

What is claimed and desired to be secured by Letters Patent is as follows:

1. A wastewater treatment apparatus comprising:
  - a) a first anaerobic region adopted to receive influent wastewater containing organic material and phosphorus and biomass so as to mix the wastewater and biomass to form a mixed liquor; said first anaerobic region having a first average solids retention time associated therewith;
  - b) a second anaerobic region flow connected with said first anaerobic region; said second anaerobic receiving flow of mixed liquor from said first anaerobic region and returning flow to said first anaerobic region; said second anaerobic region being sized and shaped so as to have a second average solids retention time that is substantially longer than said first solids retention time;
  - c) an aerobic region operably receiving flow of

mixed liquor from said first anaerobic region; and

- d) a clarification region operably receiving mixed liquid from said aerobic region for operably separating the biomass from liquid exiting said aerobic region; said clarification region being flow connected to said first anaerobic region to allow transfer of at least a portion of the biomass separated in said clarification region to said first anaerobic region.

2. The apparatus according to Claim 1 wherein:

- a) said second anaerobic region is located in a physically separate containment from said first anaerobic region.

3. The apparatus according to Claim 2 including:

- a) a conduit and pump operably connected between said first and second anaerobic region so as to urge flow of mixed liquor into a bottom of said second anaerobic region and thereafter overflow said second anaerobic region back to

said first anaerobic region.

4. In a wastewater treatment apparatus having an anaerobic region wherein influent wastewater is mixed with biomass to form a mixed liquid which is thereafter transferred to an aerated region after a first average solids retention time; the improvement comprising:
  - a) a second anaerobic region flow connected to said first anaerobic region so as to receive a flow of mixed liquor from and return said flow to said first anaerobic region; said second anaerobic region having a second average solids retention time that is significantly longer than said first solids retention time.
5. The apparatus according to Claim 4 wherein:
  - a) said second anaerobic region is configured such that liquid flow is initially into the second anaerobic region near the bottom thereof and thereafter through and out of the second anaerobic region near the top thereof.

6. The apparatus according to Claim 4 wherein:
  - a) said first anaerobic region is sized to provide an average biomass concentration in the range from 2000 to 4000 milligrams and said second anaerobic region is sized to provide an average biomass concentration greater than 7000 milligrams per liter.
7. A process for biologically treating wastewater comprising the steps of:
  - a) flowing wastewater with organic components therein into a first anaerobic region and mixing the wastewater therein with a microorganism biomass to form a mixed liquor;
  - b) flowing a portion of the mixed liquor into a second anaerobic region wherein said biomass ferments portions of said organic components so as to produce short chain fatty acids;
  - c) returning liquid from said second anaerobic region with said short chain fatty acids to said first anaerobic region wherein phosphorus is released from the microorganisms in said mixed liquor and short

chain fatty acids are associated with said microorganism that;

- d) flowing mixed liquor from said first anaerobic region to an aerobic region wherein said short chain fatty acids are metabolized by said microorganisms and phosphorus is absorbed by said microorganisms;
- e) thereafter transferring said mixed liquor to a clarifier region wherein clarified liquid is separated from biomass; and
- f) returning at least a portion of the separated biomass with phosphorus therein to said first anaerobic region.

8. The process according to Claim 7 including the step of:

- a) flowing said biomass in said second anaerobic region at a flow rate so as to produce a biomass concentration of greater than about 7000 milligrams per liter in said second anaerobic region.

9. The process according to Claim 8 including the step of:
- a) flowing said biomass in said first anaerobic region at a flow rate so as to produce a biomass concentration of less than about 4000 milligrams per liter in said first anaerobic region.
10. The process according to Claim 7 including the steps of:
- a) measuring the average phosphorus content by weight of said influent wastewater;
  - b) measuring the average short chain fatty acid content by weight of said influent wastewater;
  - c) ensuring that the flow of mixed liquor to said second anaerobic region is sufficient to produce enough short chain fatty acids in said second anaerobic region that when combined with the short chain fatty acids in said influent wastewater the total is greater than four times the amount of phosphorus in said influent wastewater by

weight.

11. In a process for treating wastewater by mixing the wastewater with biomass to form a mixed liquor in a first anaerobic region and thereafter treating the mixed liquor in an aerobic region; the improvement comprising the step of:

a) diverting a slip stream of said mixed liquor to a second anaerobic region wherein the mixed liquor is subjected to a lower flow rate than in said first anaerobic region and thereafter returning the mixed liquor from said second anaerobic region to said first anaerobic region.

12. The process according to Claim 11 including the step of:

a) flowing a first portion of the wastewater to said second anaerobic region without initially flowing said first portion to said first anaerobic region; and  
b) flowing a remainder second portion of the wastewater directly to said first anaerobic

region.

13. The process according to Claim 12 including:
  - a) selecting said first portion as less than about 10% of a total wastewater flow.
14. The process according to Claim 11 including the step of:
  - a) flowing said mixed liquor upwardly through said second anaerobic region.
15. The process according to Claim 14 including the step of:
  - a) sizing and shaping said second anaerobic region such that the flow rate through said second anaerobic region is sufficiently slow to allow biomass to form a blanket extending from near a bottom to near an outflow from said second anaerobic region.